We claim:

1. An apparatus for cutting a material submerged in a conductive liquid medium, the apparatus comprising:

    a) a cutting electrode having an elongate cutting portion having a cutting edge;

    b) a return electrode in proximity to said cutting electrode; and

    c) a pulse and minipulse voltage source connected to said cutting and return electrodes, wherein said voltage source drives said cutting and return electrodes with a voltage comprising pulses separated by a pulse interval greater than 1 ms, and wherein each of said pulses comprises a plurality of minipulses separated by a minipulse interval of less than 1 ms;

    wherein said conductive liquid medium is heated to produce a vapor cavity around said elongate cutting portion and a gas inside said vapor cavity is ionized to produce a plasma.

2. The apparatus of claim 1, further comprising a low impedance line connecting the output of said voltage source and said elongate cutting portion, wherein micropulses within said minipulses are generated within said low impedance line by reflection of voltage transients from said vapor cavity having a high impedance.

3. The apparatus of claim 1, wherein said material is selected from the group consisting of biological tissues, cellulose and plastics.

4. The apparatus of claim 1, wherein said elongate cutting portion has a width between 1 μm and 250 μm.

5. The apparatus of claim 4, wherein said width ranges between 10 μm and 100 μm.

6. The apparatus of claim 1, wherein said elongate cutting portion has a circular cross section.

7. The apparatus of claim 1, wherein said elongate cutting portion has at least one bend.

8. The apparatus of claim 1, wherein said elongate cutting portion forms a loop.

9. The apparatus of claim 1, wherein said cutting electrode comprises a wire electrode.

10. The apparatus of claim 9, further comprising a means for advancing and retracting said wire electrode.

11. The apparatus of claim 1, further comprising a charge transfer blocking device disposed to reduce charge transfer to said material.

12. The apparatus of claim 11, wherein said charge transfer blocking device comprises an RC-circuit.

13. The apparatus of claim 1, wherein said elongate cutting portion has a diameter between 10 microns and 200 microns and extends from an insulator by 20 microns to 1 mm, and wherein said insulator has a diameter between 0.1 mm and 1 mm and has a bent tip, whereby said elongate cutting portion is suitable for capsulotomy.

14. The apparatus of claim 1, wherein said elongate cutting portion has an aspect ratio of length to width larger than 1.

15. The apparatus of claim 14, wherein said aspect ratio is larger than 5.

16. The apparatus of claim 1, wherein said plasma has a temperature greater than 100 °C.

17. A method for cutting a material submerged in a conductive liquid medium, said method comprising:

a) providing a cutting electrode having an elongate cutting portion;

b) providing a return electrode;

c) immersing said cutting electrode and said return electrode in said conductive liquid medium;

d) applying a voltage between said cutting electrode and said return electrode such that said conductive liquid medium is heated to produce a vapor cavity around said elongate cutting portion and to ionize a gas inside said vapor cavity to produce a plasma;

e) modulating said voltage in a modulation format comprising pulses separated by a pulse interval greater than 1 ms, wherein each of said pulses comprises a plurality of minipulses separated by a minipulse interval of less than 1 ms; and

f) cutting said material with an edge of said elongate cutting portion.

18. The method of claim 17, wherein said pulses have a pulse duration selected in the range substantially between 10 μs and 10 ms.

19. The method of claim 18, wherein the voltage of said pulses is varied during said pulse duration, such that a low voltage is applied for electro-chemical generation of said gas and a high voltage is applied for generation of said plasma.

20. The method of claim 17, wherein said minipulses have a minipulse duration selected in the range between 0.1 and 10 μs and said minipulse interval is selected in the range between 0.1 and 10 μs.

21. The method of claim 20, wherein said minipulse duration and a peak power are adjusted to permit spark discharges and to prevent arc discharges.

22. The method of claim 17, wherein each of said minipulses comprises micropulses having a micropulse duration selected in the range between 0.1 and 1 μs.

23. The method of claim 17, wherein said minipulse interval is shorter than a lifetime of said vapor cavity, and wherein said pulse interval is greater than said lifetime.

24. The method of claim 17, wherein said minipulses exhibit alternating positive and negative polarities.

25. The method of claim 17, wherein said plasma has a temperature greater than 100 °C.

26. The method of claim 17, wherein the temperature of said elongate cutting portion is maintained between about 100 and 1,000 °C.

27. The method of claim 17, further comprising preventing charge transfer to said material.

28. The method of claim 17, wherein said material is selected from the group consisting of biological tissue, cellulose and plastics.

29. The method of claim 17, wherein said elongate cutting portion has an aspect ratio of length to width larger than 1.

30. The method of claim 29, wherein said aspect ratio is larger than 5.

31. The method of claim 17, wherein said elongate cutting portion has a width between 1 and 250 microns.

32. The method of claim 31, wherein said elongate cutting portion has a width between 10 and 100 microns.

33. The method of claim 17, wherein said elongate cutting portion is a wire with diameter between 1 and 250 microns.

34. The method of claim 33, wherein said elongate cutting portion is a wire with diameter between 10 and 100 microns.